

Building R&D / Heating & Cooling Equipment / Oilheat Projects

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NYSERDA Heating and Cooling Research

Integrated Energy Systems Peer Review
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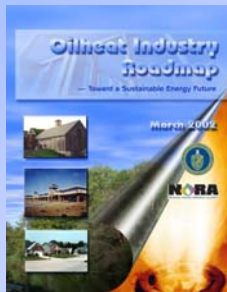
Purpose & Objectives - NYSERDA Oilheat Program

- Seeks Innovative Heating & Cooling Technologies
- Provides for Advancements in Energy Efficiency
- Enables Enhanced Environmental Performance
- Promotes Fuel Diversification & Free Market Choice
- Reduces Dependence on Imported Energy
- Supports Commercial Development Process
- Enables Growth in Manufacturing & Economy

Oilheat Industry Roadmap - Towards a Sustainable Future

Primary Target Areas

- Improving fuel quality and performance
- Enhancing equipment and service
- Expanding markets and applications



NYSERDA - Heating & Cooling / Oilheat Equipment Research strongly related to all 3 primary target areas

Fuel Technology - verifying benefits associated with low sulfur heating fuel & biodiesel blends as well

Enhancing Equipment - 3 projects aimed at new high performance low environmental signature oil burner development

Past work in Flame Quality Monitoring resulted in commercial development of technology by Honeywell

NYSERDA Oilheat Projects Related to the DOE/BNL Program

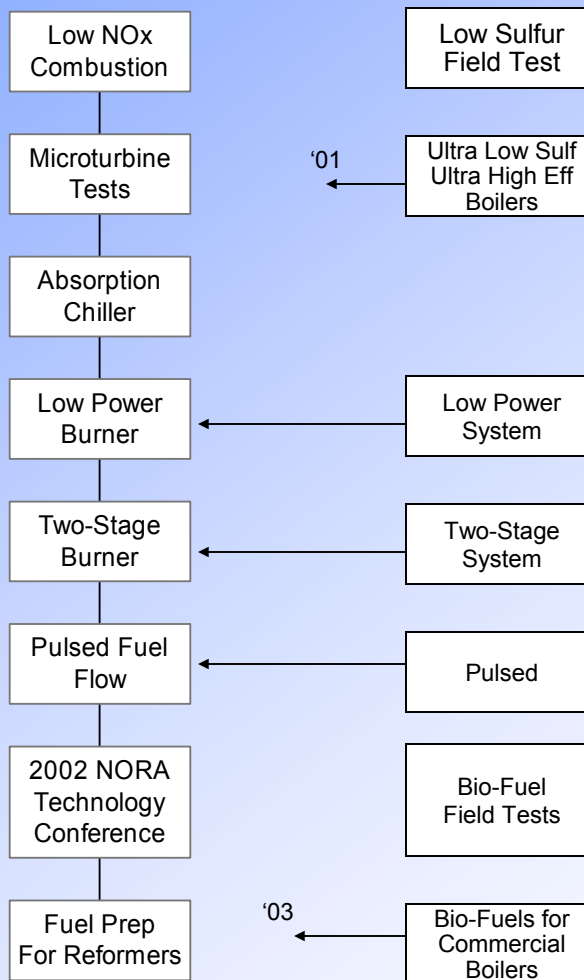
- Improved Electric Power Efficiency in Heating Equipment
- Load Tracking Control System with Two-Stage Residential Oil Burner
- Variable Firing Rate Oil Burner Using Pulsed Fuel Flow Control
- High Efficiency Condensing Heating Appliances Firing Ultra low-Sulfur Oil
- Low-Sulfur Heating Oil Field Study
- Use of Biofuel Blends in Space Heating Equipment
- Low Cost Biofuel Development

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DOE-IES-BNL-NYSERDA Program Links

DOE + NYSEDA

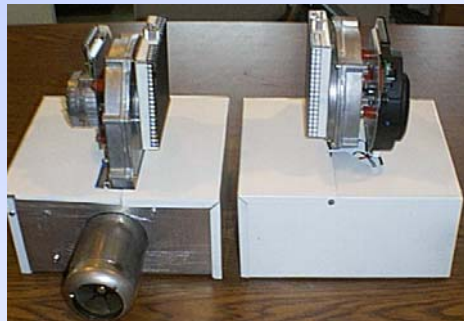
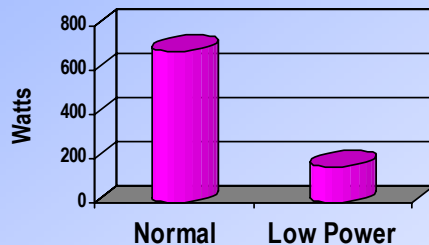


Improved Electric Power Efficiency in Heating Equipment

Phases I (FY 01) & II (FY 02):

- Ancillary components consume large amounts of HIGH cost energy
- Power grid failures result from man made & natural causes - loss of heat
- Team developed hydronic boiler system using $< 1/4$ normal electric power
- Two products developed, both very efficient, one is AC power dependent
- One independent of power grid failure with a back-up heating capacity
- Two oil burners developed, 120 volt AC & the other 12 volt DC
- DC unit designed to operate up to four days on battery with Smart Control

Electric Power Savings



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Improved Electric Power Efficiency in Heating Equipment

Phases III (FY 03):

- Limited production control unit & energy smart burners for evaluation testing in 20 homes during 2002/2003
- Laboratory measurements of pre-production design power consumption & emission signature
- Analysis of results from laboratory & field evaluation tests
- Production commitment and final report on project and commercialization plans
- Commercialization: Heat Wise Inc. & Insight Technologies Inc.

Load Tracking Control System with Two-Stage Residential Oil Burner

Phase I - Develop prototype 2-Stage Oil Burner

- 2:1 turndown with 5-10 % AFUE gain using HFAB burner design
- low NOx emission (~65 ppm) & develop protocol for smart staging control
- preliminary market study / cost analysis

Status: *Completed with all goals satisfied*

Phase II - Design & build an integrated system

FY 2002

- all features required for operation in a home
- build prototype microprocessor based control
- conduct engineering evaluations with real loads
- evaluate results complete final market study & report

Status : *On target with evaluation tests under way*

Future Commercialization:

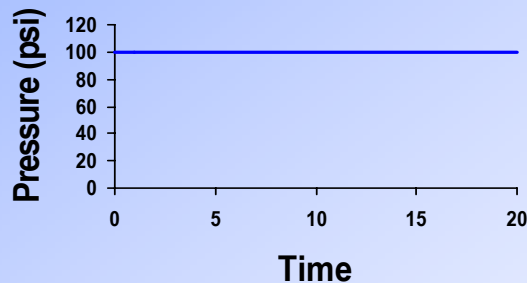
Heat Wise Inc. & Insight Technologies Inc. **NYSERDA**



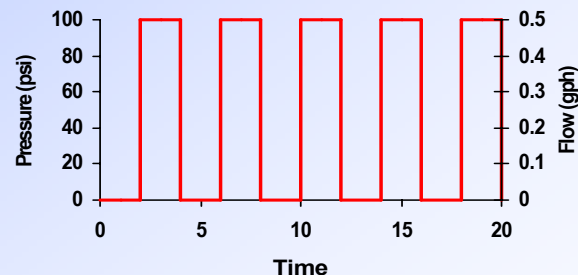
Variable Firing Rate Oil Burner Using Pulsed Fuel Flow Control

- Current burners use pressure nozzles limiting firing rate to ~ 0.5 GPH
- Lower firing rates can improve system efficiency by reducing cycling
- Pulsing fuel to nozzle & varying duty cycle can achieve good spray & low overall flow - achieved by incorporating a low mass solenoid valve
- Partnership - Lee Co. - The Lee valve and Lee solid state driver
- Cold flow tests done to measure the flow rate control
- Cold spray tests in the Malvern analyzer to obtain drop sizes
- Preliminary combustion tests

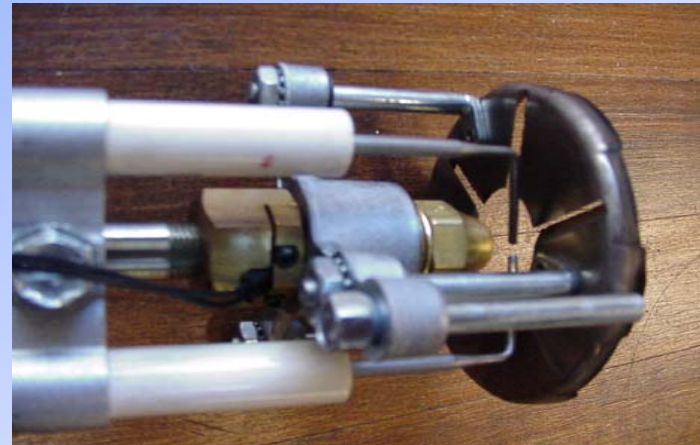
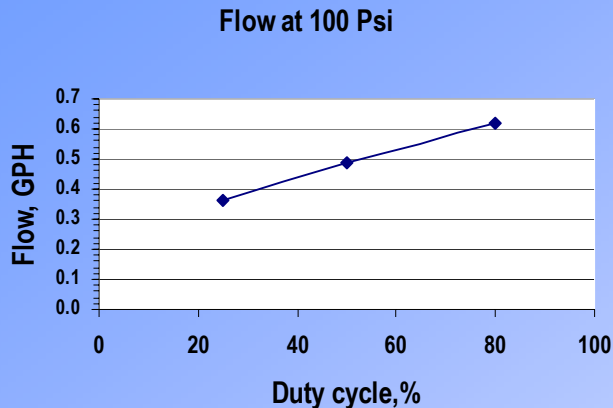
Conventional, fixed pressure



Pulsed fuel



Variable Firing Rate Oil Burner Using Pulsed Fuel Flow Control



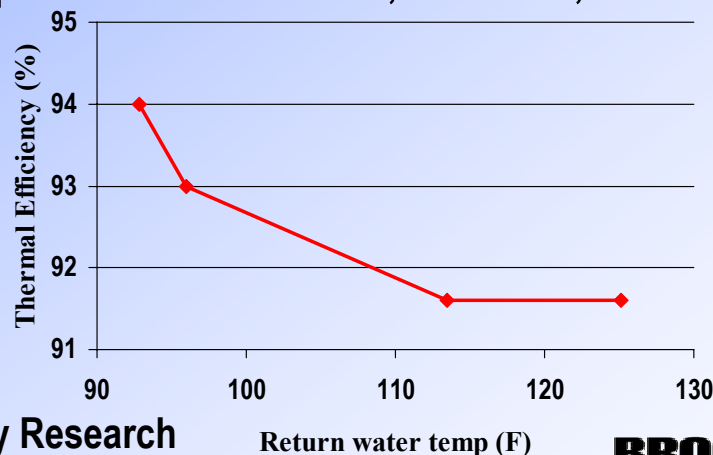
- Flow variation demonstrated
- Combustion tests in a conventional burner done
- New York manufacturer funded by NYSERDA has adapted its burner design and BNL is beginning combustion tests

Commercialization: The Lee Company & Heat Wise Inc.

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High Efficiency Condensing Heating Appliances Firing Ultra low-Sulfur Oil

- Condensing boilers have efficiency levels in the 90-95% range
- Sulfur related corrosion and fouling have made these expensive, hard to maintain and unreliable
- Objective: Measure short and long term performance with ultralow sulfur content heating oil
- Accomplishments: European condensing boiler tests started at BNL, Steady state efficiency tests completed, Condensate characterization tests in progress, Long term fouling tests starting in May
- Industry Cooperation: Geminox, MultiOil, ERC International, Tosco Refinery



Low-Sulfur Heating Oil Field Study

Benefits Documented by Prior Work at BNL:

- Reduces SO_2 emission by a minimum of 80% over normal fuel
- Supports maintaining high efficiency over long time intervals
- Significantly reduces difficult maintenance required during tune-ups
- Slightly lower fuel nitrogen leads to small reduction of NO_x emission



0.04% Sulfur



0.18% Sulfur



0.34% Sulfur



1.08% Sulfur

Low-Sulfur Heating Oil Field Study

NYSERDA Project - No Direct DOE Cost Share

- Field evaluation in 900 homes in Scotia, NY
- Energy savings, market practice versus laboratory benefits
- Does SO₂ emission reduction match expectations
- Do service benefits translate into actual cost reductions
- Equipment concerns, fuel pump reliability indicator
- 2 cents per gallon fuel differential, cost a factor

Result To Date:

- Full year with complete heating season supplied with low sulfur (0.05%) product
- No equipment problems reported, no pump concerns
- Fuel price differential twice that expected, four cents per gallon
- Sulfur dioxide emission 80% reduction confirmed
- Study continuing to seek answers with regard to energy and cost savings

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Biodiesel - A Path to a Sustainable Energy Future



Biodiesel is oxygenated (10- 12% Oxygen) fuel made from Virgin or Recycled Vegetable oils or Animal Fats.

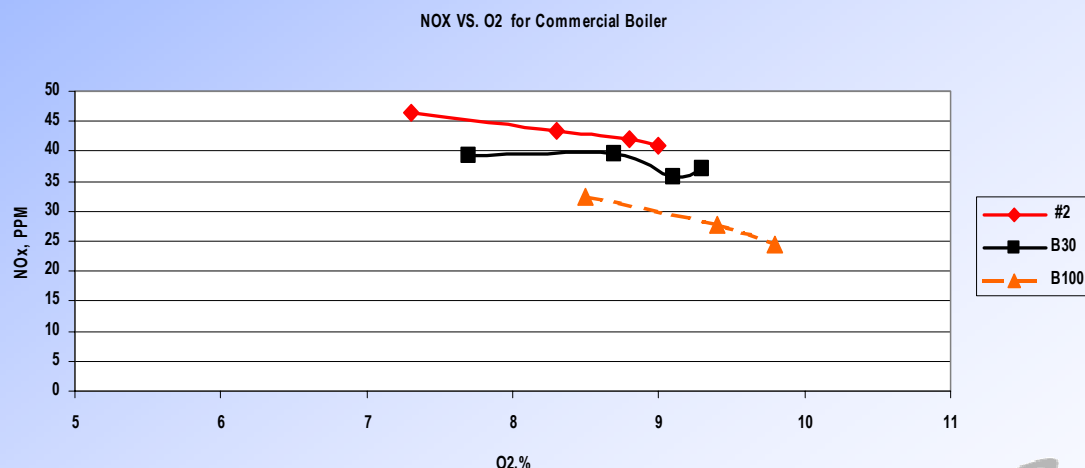
Biodiesel is a Renewable Energy Source and Can reduce CO2 Emissions, Global Warming, NOx and Particulate Emissions

Biodiesel Blends can be Used in diesel engines or Heating Systems With Little or No Modifications

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Use of Biodiesel Blends in Space Heating Equipment

- Biodiesel blends with heating were oil tested in both a residential and commercial hydronic boiler systems designed for space heating
- Significant reductions (10-30%) in stack NO_x emission with B50
- Field evaluations of a B20 blend in about 100 homes carried out over the last heating season 2001/2002
- No problems reported so far by Abbott and Mills
- Field evaluations be continued with low sulfur fuel



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Low Cost Biofuel Development

- Under NYSERDA sponsorship, research on a potentially low cost biofuel will be carried out
- NOCO Energy Corp., BNL and ADM will collaborate
- Initial tests with blends of Soy Methyl Ester byproduct from ADM in No. 2 fuel oil
- Next, SME will be blended with residual oil (No.6) in different ratios and tested in a commercial boiler
- Effect on PM 2.5 emissions will be assessed
- Field Tests will be carried out at a heating plant in a school

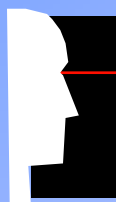
Public Partnerships



*State government and Federal government Agencies
working cooperatively together for an energy efficient
future with a clean environment!*

Public and Private Partnerships

Working cooperatively together for an energy efficient future with a clean environment with the private sector!



Insight Technologies

HeatWise, Inc.

Dunkirk Radiator Company

NOCO Energy Corp.

Davis Aircraft Company

AMD Company

Honeywell Inc.

Abbott & Mills Inc.

Buhrmaster Energy Group



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New York State Energy Research
and Development Authority

